



Constructive Character-Based Problem Solving to Enhance Students' Learning Outcomes in Physics Subject

Anggi Susilawati✉, Meriza Faradilla, Reka Julia Utama

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Universitas Bina Bangsa Getsempena Aceh, Indonesia

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Abstract

The purpose of this study is for investigating whether constructive character-based problem solving can enhance students learning in physics subject. This study utilized quasi experiment by research design was equivalent control group design. The sample of this study was 28 students of grade IX which were divided into two groups. The first group was experimental class with 14 students who receive constructive character-based problem-solving learning. The second group was experimental class with 14 students who receive conventional learning with constructive character. The results obtained that based on students' learning outcomes in the experimental class, the percentage value is 88.4% higher than the control class which is only 56.9%. Meanwhile for the constructivist character in the experimental class is also higher by 80% and in the control class by 68.5%. For the value of hypothesis test which has been conducted is obtained the t_{count} value is $2.247 > t_{\text{table}}$ 1.67. This means that problem solving learning based on constructivist characters has an impact on students learning outcomes in physics subject. With the result that it can be concluded that problem solving learning based on constructivist character is more effective to be implemented for enhancing students learning outcomes in physic subject.

How to Cite

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✉ Correspondence Author:
E-mail: anggi@bbg.ac.id

INTRODUCTION

Indonesian education field is currently known to have new program called *Merdeka Belajar*. This program is a new policy to create an atmosphere so that the teachers and students have cheerful feeling in the learning process (Yamin, and Syahril 2020). This program is associated with sharp analytical skills, reasoning and comprehensive understanding so as to be able to expand students' self-ability (Saleh 2020). In this process, the students are demanded to be able to solve problem independently in order to gain an understanding analysis and reasoning ability that is much better than before.

Problem solving ability is related, one of the things, to the character of students to be able to apply the knowledge they have in the learning process. Character is a very important thing that can be built in learning by teachers for students so that they can implement knowledge more flexibly, where learning with constructivism can provide positive results for the motivation and character formation of students (Sabinus, 2023). Apart from that, students must also be able to construct several abilities they have based on the constructive character that is built from the learning carried out by teachers at school. So that students can form and use their character to solve various problems faced in the learning process.

Nowadays, an individual is demanded to have several abilities such as critical thinking, problem solving, communication, collaboration, creating, updating, information technology literacy, communication, contextual learning, and media literacy in the learning process (Nurpritiani 2020). According to the Ministry of National Education, learning aims to enable students for understanding concepts, reason, solve problem, communicate ideas, and have an attitude of respect related to science in everyday life.

Problem solving is a significant ability which students have in order to encourage them for developing theory independently, testing with their friend's theory, discarding if the theory is inconsistent and striving to something else (Mulyani et al. 2021). Problem solving learning, the students are demanded to learn more independently and undertake to develop their creative thinking so as to improve their abilities to deal with the problems they face. Problem solving is able to create effective learning conditions and provide stimulus for memory work by searching information to answer the problems face.

Problem solving in learning does not only observe on the students' independence and crea-

tivity they have but also students also need a certain character that is able to assist them in solving the problems that can build new knowledge in accordance with the demands that must exist on students. It means that students are required to find by themselves what they learn and they are responsible for their learning outcomes, and are required to create reasoning from what they have learned by looking for the meaning, comparing what is known both new experiences, and transferring knowledge from the teacher to them, where this is an activity which can enable students to build their knowledge independently (Pardede 2021).

The result of problem solving can be achieved by building the constructivist character of students (Raharjo, and Sulaiman 2017). Where the constructivist character can be seen from collaboration, mutual support, fun and not boring, passionate learning, integrated learning, using various learning resources, active students, sharing with friends, critical students and creative teachers, as well as the report to parents in the form of portfolio.

Based on the results of observations carried out in several schools in Aceh, it was found that there are still many students who are not able to use their character in solving problems given by the teacher, besides that there are still many students who are not able to understand some physics material properly. good and correct, and it is still found that students are not able to implement the concepts obtained to solve problems given by the teacher, and there are still many students who have learning outcomes that tend to be low. This is also supported by several literature conducted by researchers, such as Khairuna, et al (2021) stating that student learning outcomes tend to be low, this is because students still lack their problem solving abilities. Putri, A.A. (2021) states that problem-solving abilities for learning outcomes are still relatively low with regard to physics concepts. According to Nurjannah, E., et al (2021) stated that in physics learning the learning outcomes of students are still low, this is because after learning students have not been able to apply the concepts, so they are less able to solve problems related to the various questions given by the teacher. In addition, Mardiah (2023) stated that there were still many students whose thinking activities were lacking. This is due to the lack of ability of students to construct character in solving problems based on the learning results obtained.

The factors that cause student problem solving are still low because there are still many

teachers who tend to dominate themselves in the learning process at school, which makes students less able to gain knowledge independently, especially in Physics material. In addition, the lack of students' skills in solving problems, so that students are unable to solve the various problems they face and students still lack constructivist abilities in learning. Whereas in general, constructivists will allow students to be able to create their knowledge from the experiences offered (Darko, C., & Zadoroshnyj., 2021; Bada, S.O., & Olusegun, S., 2015). In addition, Hayatun (2023) states that solving problems with a constructivist approach can improve students' critical thinking abilities which will make student learning outcomes better. Where constructivist character demands the students to be able to build knowledge, create meaning, ask the clarity concepts they are learnt and can lead to critical thinking.

Based on the outline above, this study aims to investigate whether constructivist-based problem solving can enhance the students' learning outcomes in physics subject.

METHOD

This study used quasi experiment study. The population of this study was the students of grade IX and there were 28 students as sample. The samples used was calculated by using Slovin formula and taken by using random sampling method. In this study, the sample was divided into two groups, the first experimental class group was consisted 14 students with problem solving learning based on constructivist character, and the second group was consisted 14 students as well by using conventional learning or those commonly used by teacher in learning at the school.

There were two instruments used in this study, namely observation sheet for viewing the constructivist character of students' problem solving by using several indicators. It was measured and the result would be seen such as observing, identifying, presenting and concluding the results. The test instrument in the form of Essay question for viewing students' physics learning outcomes with total of 5 questions.

The experimental class and control class will be carried out with a pre-test to see the students' initial abilities before learning is carried out and in the final stages of the two classes a post-test will be carried out to see students' final abilities after learning is carried out.

The instrument of this study before being used was tested for validity and reliability to notice whether the instrument was worthy or not to

be used. Furthermore, the test instrument in this study was tested for the level of difficulty and distinguishing power. For enhancing learning outcomes was seen from the value of N-Gain.

Before being used, this research instrument was tested for validity and reliability, this was done to see whether this instrument was feasible or not to be used. Furthermore, the previous test instruments were tested for difficulty level and discriminatory power. To improve student learning outcomes can be seen based on the value of N-gain and the difference in significance of learning outcomes related to hypothesis testing is done using the t-test. The N-gain category can be seen in Table 1 below.

Table 1. Category of N-gain values

Gain Value	Category
gain > 0,7	High
0,7 gain 0,3	Medium
gain < 0,3	Low

(Source: Hake, 1999)

RESULT AND DISCUSSION

This research was conducted to see the learning outcomes of the experimental class with problem solving to see the constructivist character of the students, and one other class was the control class with conventional learning. From the results obtained in both classes, namely experimental and control, the learning outcomes obtained can be seen in the table below.

Table 2. The Percentage of Learning Outcomes for Experiment and Control Class

Class	Pre-test	Post-test	N-gain
Experiment	3,2	16,8	0,8
Control	3,9	12.32	0,5

Table 2 shows that the average pre-test learning outcomes of the two classes initially tended to be relatively the same, where the experimental class was 3.2 and the control class was 3.9. Meanwhile, the average post-test score differed significantly for the post-test score, where the average value of the experimental class was 16.8, which was greater than that of the control class, which was only 12.32. Based on Table 2 above, it also shows that the value of increasing learning outcomes is reflected in the N-gain value of the experimental class of 0.8 in the high category with problem solving learning while for the control

rol class it is only 0.5 in the medium category. Based on the learning outcomes obtained by both classes, it can be seen that learning with problem solving is quite effective in increasing the learning outcomes with different constructive characters possessed by students in the experimental class and control class.

These results indicate that learning carried out by problem solving is better at improving student learning outcomes compared to conventional learning. where by learning problem solving students can discover concepts independently and process knowledge based on direct understanding and make learning fun, so that it can motivate students in learning which can improve their learning outcomes (Susilawati, 2022). In addition, problem solving does not only present something mathematically, but also physically involves students, especially in the physics learning process (Nita, 2023). So that abstract concepts in physics can be understood well by students directly, which makes students more active and innovative in learning, so that it can influence their learning outcomes.

The value of the constrictivist character of students for the experimental class and control class based on the constructivist character indicators in this study can be seen based on Table 3 and 4 below.

Table 3. The Students' Constructivist Character of Experimental Class

Character	Average
Observation	3,4
Identification	3,5
Analysis	3,3
Presentation	3,7
Conclusion	3,6
Total	17,5
Percentage	87,5%

Table 4. The Students' Constructivist Character of Control Class

Character	Average
Observation	1,9
Identification	2,1
Analysis	1,7
Presentation	1,8
Conclusion	2,1
Total	9,6
Percentage	68,5%

Based on Table 3 it can be seen that in the constructivist character of the experimental class of 14 people all with an average value of observation 3,4, identification 3,5, analysis 3,3 presentation 3,7 and conclusion 3,6 with the total number 17,5 with an overall percentage value of 87,5%. Meanwhile, for the constructivist character of the control class which can be seen in Table 4, it can be seen from 14 people, the average value of the observation indicator is 1,9, identification is 2,1, analysis 1,7, presentation is 1,8 and conclusion is 2,1. With a total value of 9,6 with a percentage value obtained of 68,5%.

Based on the value of the constructivist character, it can be seen that the constructivist character of the experimental class is greater than the control class, both in terms of observation, identification, analysis, presentation and conclusion, this shows that the constructivist character with problem solving is more effectively used in learning, compared to conventional learning. . This is because learning based on problem solving will invite students to build a more real learning character. Besides that, according to Saputro (2021) learning that is done with constructivism is best suited to problem solving, because learning by problem solving is done by presenting problems at the beginning of learning by presenting real problems related to the material being studied. So it is very suitable to be used to improve the constructivist character of students.

For a clearer comparison of the percentage of constructivist characters in the experimental class and the control class, it can be seen in Figure 1 below.

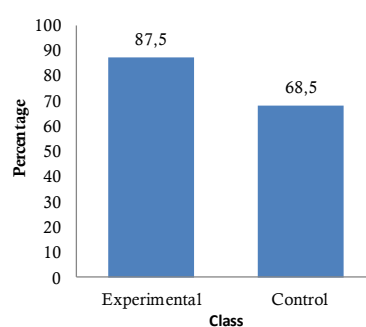


Figure 1. Percentage of constructive character values for the experimental class and the control class

The results showed that the experimental class with problem solving learning has average score and percentage higher than control class. This shows that problem solving learning has better constructivist character than conventional

learning. The high percentage obtained in this experimental class is because students are starting to be able to construct learning more meaningfully with concepts discovered based on problem solving carried out by students. Where this is as stated by Komisia, et al (2023) who state that learning will be more meaningful with problem solving that is able to solve problems so that they can organize, develop independence, form more meaningful knowledge and self-confident.

For the difference percentage score between experimental and control class is able to be seen in the Figure 2 below.

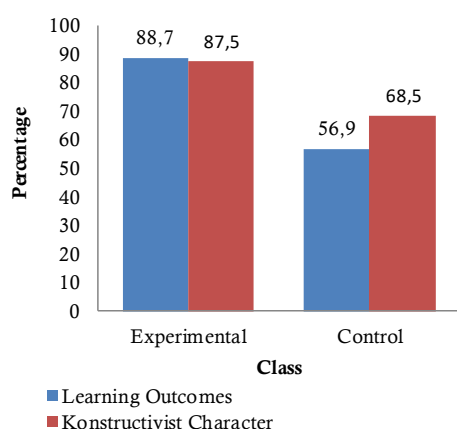


Figure 2. The Percentage Comparison between Experimental and Control Class for Learning Outcome and Constructivist Character

Based on Figure 2 above, it can be seen that in the experimental class the average percentage value obtained for learning outcomes was 88,7% and the constructivist character was 87,5%, this result was greater than in the control class where the average percentage of student learning outcomes was only 56,9% and constructivist character of 68,5%. Based on the results obtained, it shows that problem solving learning based on constructivist characters is very positive and effective compared to conventional learning that is usually used by teachers in school learning.

Based on the hypothesis testing carried out using the t-test, it was found that the value of $t_{count} 2,247 > t_{table} 1,67$, this means that learning problem solving based on constructivist characters is related to the acquisition of learning outcomes from students in learning, especially Physics. The results obtained are also supported by several previous studies related to problem solving and constructivism. Satiyadi et al. (2018) stated that problem solving can be improved by using learning that involves direct learning, where a learning process that involves students directly will

make students more understanding of the concepts they are learning by pouring all knowledge, thoughts and skills they have to solve problems faced by students in learning today. Luthfiah (2023) states that problem-based learning emphasizes direct learning involve students, giving real life problems, so this thing making knowledge that students will remember longer or be more meaningful compared to teacher-centered learning.

Nurpatri et al. (2021) stated that students are required to be able to study at home, where they are required to be able to study extra so they can understand the material they are studying in depth. In order to overcome this problem, constructivist learning can be applied, where with constructivist learning a student can increase his understanding of a material independently and students can express their ideas and express their thoughts on a concept that he understands. In addition, Rullis, and Fauzan (2021) states that interactive learning can be done through constructivist learning, where with constructivist learning students can develop their own understanding, knowledge, and independence in learning. Ristiasari et al (2012) stated that to be able to live his life, a student must be able to solve the problems faced and must get a problem so that it becomes an experience to be able to continue his life and make the problem a lesson in solving problems.

According to Asyrofi, and Junaedi (2016) constructivism relates to students' ability to create, transform and also organize knowledge. Constructivists are concerned with an individual needing to create theories, change, distribute, print new information directly. If the thing in question is not appropriate, it will be difficult for students to be able to master knowledge, it is difficult to solve problems and it is difficult to find new ideas independently. According to Halim, et al 2016 students must be able to become problem solvers in order to solve the problems they face, this can be done with problem solving based learning. With problem-based learning students can face global competition, because students not only have cognitive knowledge, but also have technical or procedural related knowledge and have a strong correlation to the structure of their knowledge.

Student problem solving in outdoor learning is considered better than indoor learning and is very effective in use, this is because with outdoor learning students are faced with direct situations that will make them construct, understand and be able to apply the concepts learned directly, so that students will be practiced to be able to find various concepts that are owned holis-

tically, meaningfully, authentically and applicable to solving problems (Wahyuni et al. 2017). Hoper et al. 2022 stated that outdoor learning can create a new learning atmosphere for students who usually study indoors, so that the concepts obtained appear directly which will make students able to understand the concepts in everyday life.

This study looks at student problem solving based on the constructivist character they have in solving physics problems which will affect learning outcomes, where problem solving and constructivism also have in common where a person is required to gain understanding based on the work independence that exists in him. The teacher here is only a facilitator who helps students if there are indeed obstacles in discovering the concept.

At the beginning of the research, experimental class students were invited to solve problems in the concept of Physics which would then be assessed for their constructivist character. The character that is assessed is observing, in which observing a student is seen how to use several senses such as hearing, observation, and touch to collect the data needed after conducting an experiment. Then identify related students in searching, finding, collecting, conducting experiments, and recording experimental data. Furthermore, it can analyze related to the data from after conducting the experiment. Then presenting, where a learner must be able to communicate related to the results of the discussion in a real, appropriate and effective manner. For the latter with regard to concluding, where a learner must be able to conclude the results of experiments that have been carried out and discussed.

Based on all the constructivist characters that exist in this study, all of them are to see how students can and are capable of solving problems based on the characters that are built from solving these problems. So that they will be able to express themselves based on their understanding and abilities, so that constructivist character-based problem solving is very well applied in learning.

This is also in accordance with Ikhtiati, et al (2022) who states that character can be formed through students' ability to solve problems generated with various examples, so that reasoning and active thinking can take place in developing students' character and will influence student learning outcomes..

Student learning outcomes have increased because learning is done based on problems, this is because problem solving does not only focus

on the material, but also invites students to solve problems in finding the learning concepts they learn. then the solving ability will implement the character of students in learning, so that students not only learn from the results that can be built but also constructivist characters from solving the problems they do.

CONCLUSION

Based on the study that had been conducted by the writer, it can be concluded that problem solving based on character constructivist can enhanced students' learning outcomes in physics subject. This can be seen from the percentage of study score obtained on experimental class that is 88.7% meanwhile on control class the percentage is 56.9%. For constructivist character on the experimental class is 87,5% and on control class is 68.5%. Whereas for hypothesis by using t-test is obtained $t_{\text{count's}} 2,247 > t_{\text{table}} 1,67$. This means problem solving learning based on constructivist character has significant effect on students' learning outcomes in physics subject. Therefore, from the result can be seen that problem solving based on constructivist character is effective to use for enhancing learning outcomes in physics learning.

Based on the results and discussion it is also seen that problem solving is very effectively used to build and improve constructivist characters, such as observation, identification, analysis, presentation, conclusion. This large value is due to the fact that in building a constructivist character, students are first introduced to basic problems related to learning concepts, then these problems will be solved directly by students, so that it will influence the understanding of the concepts obtained and will improve student learning outcomes.

Improving student learning outcomes in physics learning, where this can also be caused because students will be directed to be able to understand a problem based on existing concepts more clearly based on the character of learning from the results of teacher teaching and the knowledge they gain directly and independently, so students will acquire more meaningful knowledge and will enable students to process their knowledge and constructivist character more fully in solving problems in the learning process. So overall it can be concluded that constructive character-based problem solving can improve student learning outcomes in physics subjects.

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